Remarks

Claims 1, 8-15, 19, 22-28 and 30 remain in the application. Claims 2-7, 16-18, 20, 21, 29, and 31-33 have been cancelled. In the Office Action, claims 1 and 13 were rejected on the basis of 35 USC 102(b), as follows:

> Claims 1 and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Waldron et al. (USPN 6168067 B1).

According to the U.S. Patent Office,

> Waldron teaches a method of welding Al alloy by aging before and after welding (col. 3 line 36 - col. 4 line 5 and col. 5 lines 22-36) to a predetermined temperature for a predetermined time to induce precipitation hardening (col. 6 lines 12-24), particularly to temperatures between 100 C and 300 C for a period of hours (col. 6 line 61 - col. 7 line 40).

The rejection is respectfully traversed.

Applicant's invention includes the steps of providing a 7xxx series alloy, aging to precipitate GP zones and coherent η' precipitate, friction stir welding, and aging to 7X condition. It should be noted that friction stir welding is ***welding without melting***. This is defined in Applicant's specification at page 10, paragraph [0033], as follows:

> [0033] Friction stir welding refers to a method of joining aluminum members together. In friction stir welding, a probe is inserted against or between a pair of opposing faces of members to be joined. Then, the probe is rotated. The rotation of the probe creates friction sufficient to generate heat to plasticize material at the opposing faces ***without melting*** the material. This results in a weld joint forming as the plasticized portions flow together and solidify to form the weld zone. (Emphasis added.)

Applicant's claim 1 is set forth below for convenience.

> 1. A method of welding age-hardenable aluminum alloy to improve strength properties in a heat affected zone and a weld zone, the method comprising the steps of:
>
> (a) providing precipitation hardenable 7000 series aluminum alloy members to be welded;
>
> (b) subjecting said members to a first aging step for times and temperatures to generate GP zones and coherent η'

strengthening precipitates to provide aged members;

(c) friction stir welding said aged members to provide a welded assembly having a weld zone; and

(d) subjecting said welded assembly to a second aging step to reprecipitate strengthening GP zones and coherent η' precipitates dissolved in the weld zone during the welding step, the second aging step being a T7X aging step.

The Office Action states that Waldron teaches a method of welding aluminum alloys by aging before and after welding, and cites col. 3, line 36, to col. 4, line 5, and col. 5, lines 22-36.

Col. 3, line 36, to col. 4, line 5, is as follows:

In order to improve the mechanical properties of the structural member 22, including the strength, hardness, and corrosion resistance of the member, the member is preferably precipitation hardened. Precipitation hardening of metal alloys is a process whereby the mechanical properties of the metal alloy are improved by the formation of uniformly dispersed particles or precipitates of one or more secondary phases within the original phase matrix. Precipitation hardening requires that the metal alloy undergo two heat treatment processes, the first process being a solution heat treatment and the second process being a precipitation heat treatment.

Referring to FIG. 2B, there is shown a hypothetical phase diagram for a precipitation-hardenable metal alloy composed of alloying elements A and B. Although FIG. 2B illustrates a phase diagram for a binary system, precipitation-hardenable metal alloys may contain two or more alloying elements. For a metal alloy to be precipitation hardenable, the alloy must have an appreciable maximum solubility of one element in the other, on the order of several percent; and a solubility limit that rapidly decreases in concentration of the major element with temperature reduction. Both of these requirements are satisfied by the hypothetical phase diagram of FIG. 2B, where the maximum solubility is designated by M. Additionally, the composition of a precipitation-hardenable metal alloy must be less than the maximum solubility M. Examples of some of the binary and ternary metal alloys that are precipitation hardenable include aluminum-calcium, aluminum-chromium, aluminum-cobalt, aluminum-copper, aluminum-iron-titanium, aluminum-gallium-germanium, aluminum-gallium-indium, aluminum-germaniumtin, aluminum-lithium, aluminum-lithium-magnesium, aluminum-manganese, aluminum-molybdenum, aluminum-nickel-titanium, aluminum-niobium, aluminum-silicon, copper-beryllium, copper-tin, magnesium-aluminum, as well as some ferrous alloys.

It is respectfully noted that col. 3, line 36 through col. 4, line 5, does not teach aging ***before welding***. Instead, this merely refers to the prior practice of aging. Nowhere in this quotation is there any reference to ***welding***. It should be noted that "22" only refers to a structural member formed of a precipitation-hardenable alloy having two more ***alloying*** elements. Thus, for a first reason, claims 1 and 13 cannot be rejected under 35 U.S.C. §102(b), and thus for this first reason, Applicant's invention is patentable over Waldron.

It is respectfully submitted that to argue that Waldron teaches aging before welding is contrary to Waldron. That is, Waldron only teaches solution heat treating before welding. Therefore, Waldron cannot anticipate or even make obvious Applicant's invention because Waldron is ***silent*** with respect to critical features of Applicant's invention; that is, aging before welding.

For a rejection under §102, the reference must show ***all*** the features or elements of the claim within its four corners. For an invention to be anticipated under 35 U.S.C. §102(b), the reference must teach every aspect of the invention. This rule is set forth in the MPEP, §706.02, as follows:

> . . . for anticipation under 35 USC 102, the reference must teach every aspect of the invention . . .

This rule has been adopted by the courts. For example, the District Court, D. Delaware, Studiengesellschaft Kohle mbH v. Dart Industries, Inc. 216 USPQ 384, stated the Third Circuit test for anticipation, which is as follows:

> For a prior publication to defeat a patent it must exhibit a substantial representation of the invention in such full, clear and exact terms that one skilled in the art may make, construct and practice the invention without having to depend on either the patent or on his own inventive skills.

For a §102 rejection, *In re Marshall* 198 USPQ 346 sets forth the standard, as follows:

> Rejections under 35 USC 102 are proper only when the claimed subject matter is identically disclosed or described in the prior art.

Clearly, the Waldron citation is not identical to Applicant's invention.

The number 22 is only referred to in Fig. 2A of Waldron. Fig. 2A of Waldron indicates in the "Brief Description of the Drawings" that "Fig. 2A is a perspective view showing a structural member of preselected dimensions fabricated from a precipitation-hardenable metal alloy, as is known in the art. Again, there is no reference to welding. Thus, it is respectfully submitted that claims 1 and 13 are not anticipated by or made obvious by Waldron, and thus because Waldron is ***silent*** with respect to aging before welding, Applicants' invention is patentable over Waldron.

The Office Action then cites Waldron, col. 6, lines 12-24, and col. 6, line 61 to col. 7, line 40, for precipitation hardening, which are as follows:

> Once all the structural members of the structural assembly are ***joined***, the precipitation hardening of the component structural members of the assembly may be completed by ***naturally*** or ***artificially aging*** the assembly to the desired temper at a predetermined temperature schedule. Referring again to FIGS. 2B and 2C, artificial aging or precipitation heat treatment requires that the structural assembly undergo an isothermal heat treatment whereby the temperature of the assembly is raised to a predetermined temperature, designated by T_2, for a predetermined amount of time, designated t_2. The temperature T_2 is within the α and β two-phase region of the hypothetical phase diagram and is a temperature at which the diffusion rates for the B atoms become appreciable. (Emphasis added.)

It is respectfully submitted that columns 6 and 7 do not refer back to Fig. 2A, but instead to Figs. 3 and 4. Waldron teaches, referring to Figs. 3 and 4, at col. 4, lines 49 to 52, as follows:

> As illustrated in FIGS. 3 and 4, the structural members 24, 26, both of which have been ***solution heat treated***, but have an incomplete temper, are preferably joined by friction stir welding to form a structural assembly. (Emphasis added.)

Again, it will be noted that there is no reference to ***aging*** before welding but merely to ***solution heat treating***.

It must be noted that Applicant's claim 1 requires the step of aging as follows:

(b) subjecting said members to a first aging step for times and temperatures to generate GP zones and coherent η' strengthening precipitates to provide aged members;

Further, it should be noted that Waldron is ***silent*** in these citations with respect to aging prior to welding, but instead teaches only solutionizing or solution heat treatment prior to welding. These are two different concepts, as will be seen by the properties for an age-hardenable alloys shown in "Elements of Materials Science", by Lawrence H. VanVlack, Addison-Wesley Publishing Company, Inc., 1959, 1964, pp. 312 and 315, reproduced below, as follows:

Table 11-2

Properties of an Age-Hardenable Alloy (95.5% Al-4.5% Cu)

	Treatment (See Fig. 11-27)	Tensile Strength, Psi	Yield Strength, Psi	Ductility, % in 2 in.
A	Solution-treated and quenched	35,000	15,000	40
B	Age-hardened	60,000	45,000	20
C	Overaged	~25,000	~10,000	~20
D	Annealed	25,000	10,000	15

It should be noted that there is a dramatic difference in strength between solution heat treated and age-hardened.

This is also illustrated by table 11-3, page 315, as shown below:

Table 11-3

Tensile Strengths of a Strain- and Age-Hardened Alloy (98% Cu-2% Be)

Annealed (1600°F)	35,000 psi
Solution-treated (1600°F) and cooled fast	72,000
Age-hardened only	175,000
Cold-worked only (37%)	107,000
Age-hardened, then cold-worked	200,000 (cracked)
Cold-worked, then age-hardened	195,000

It will be seen that solution heat treat which occurs at 1600°F produces a strength of 72000 psi, and the aging step which occurs at much lower temperature produces a strength of 175,000 psi. Thus, these are entirely different concepts, and the Waldron citation only teaches solution heat treatment prior to welding. Accordingly, Applicant's invention is patentable over Waldron.

Waldron teaches a different invention for another reason. That is, Waldron summarizes his invention at col. 7, lines 6-40, as follows:

> Referring now to FIG. 5, there is illustrated the operations performed to manufacture a structural assembly according to one embodiment of the present invention. The first step includes ***solution heat treating*** a structural member to dissolve all solute atoms so as to form a single-phase solid solution. See block 60. The ***second step involves quenching*** the structural member to a predetermined temperature to prevent diffusion and the accompanying formation of any of the solute phase. See block 62. The first and second steps may then be repeated as necessary to solution heat treat the structural members of the resulting structural assembly. (Emphasis added.)
>
> The friction stir welding probe is then moved through the structural members along the path created by the interface of the members to thereby form a continuous weld joint along the length of the structural members. See block 68. Concurrently with the moving step, the structural members are quenched proximate to the weld zone to reduce the size of the heat-affected region. See block 70. The inserting, moving, and quenching steps may then be repeated as necessary to join any remaining structural members of the resulting unitary-structural assembly.
>
> The structural assembly is then ***aged or precipitation heat treated*** at a predetermined temperature over a predetermined time period to obtain the desired character of solute particles. See block 72. Thereafter, the structural assembly is cooled to room temperature. See block 74. The structural assembly may then be secured to other assemblies, such as adjacent wing or fuselage panels, to form the frame of an aircraft. See block 76. (Emphasis added.)

Clearly, it will be seen that Waldron teaches solution heat treatment prior to welding. Thus, Applicant's invention is patentable over Waldron.

It is submitted that Applicant's invention is patentable over Waldron for a further reason. That is, Applicant's invention requires the first aging step to generate GP zones and coherent η' strengthening precipitates. Waldron is ***silent*** with respect to such precipitates. Instead, Waldron, by solutionizing puts the elements into solution. Waldron describes this step at col. 7, lines 8-11, as follows:

> The first step includes solution heat treating a structural member ***to dissolve*** all solute atoms so as to form a single phase solid solution. (Emphasis added.)

It should be noted that solution heat treating is the opposite of aging. That is, solution heat treating puts the atoms into solution and precipitate hardening brings them out. Clearly, Applicant's invention is not made obvious or anticipated by Waldron because different processes are involved.

In the Office Action, claims 1-6 and 17 were rejected under 35 U.S.C. §102(b) as being anticipated by Evancho et al. (USPN 4082578) as follows:

> Claims 1-6 and 17 are rejected under 35 U.S.C. §102(b) as being anticipated by Evancho et al. (USPN 4082578).
>
> Evancho teaches a method of welding 2xxx Al alloy (col. 2 lines 67-69) by aging before (col. 6 lines 29-48, col. 10 lines 20-42 and col. 11 lines 3-16) and after welding to a predetermined temperature for a predetermined time to induce precipitation hardening (col. 15 lines 30-42 and claims 7, 26 and 31).

Evancho is concerned with aluminum structural members for vehicles such as automobiles. The Office Action points to col. 2, lines 67-69 for 2xxx series aluminum alloys. It is respectfully submitted that Applicant's amended claims are not concerned with 2xxx series alloys, but instead are concerned with 7xxx series alloys. As noted earlier, for a 35 U.S.C. §102 rejection, the reference must teach every aspect of the invention. This is the rule set forth in MPEP, §706.02, as follows:

> . . . for anticipation under 35 USC 102, the reference must teach every aspect of the invention . . .

Thus, Applicants' invention is not anticipated or made obvious by Evancho.

It is respectfully submitted that Applicant's invention is not anticipated by Evancho for a second reason. That is, Applicant's invention is concerned with 7xxx series aluminum alloys and Evancho is ***silent*** with respect to 7xxx series aluminum alloys. In the Office Action, Evancho col. 6, lines 29-48; col. 10, lines 20-42; and col. 11, lines 3-16 are referred to. In the first citation, col. 2, lines 67-69, there is no reference to welding. This reference is also ***silent*** with respect to 7xxx series alloys.

Also in the Office Action, it was noted that after welding, the alloys were subjected to a predetermined temperature for a predetermined time and induced precipitation hardening, and reference is made to col. 15, lines 30-42 and claims 7, 26 and 31. Col. 15 refers to Table IV which uses alloy B of Evancho which is not a 7xxx series alloy, but rather a 2xxx series alloy. Thus, Evancho is ***silent*** with respect to welding a 7xxx series alloy. Applicant's invention is patentable over Evancho for another reason. That is, in Table IV, the sheet material in Evancho is MIG welded. In distinction, Applicant's invention requires friction stir welding of the aged members. Thus, for this additional reason, Applicant's invention is patentable over Evancho.

It is respectfully submitted that Applicant's invention is patentable over Evancho for another reason. That is, friction stir welding by definition does not melt the aluminum member being joined whereas in MIG welding, the members to be joined are melted. Applicant points this out at page 10, paragraph [0033] for friction stir welding, as follows:

> [0033] Friction stir welding refers to a method of joining aluminum members together. In friction stir welding, a probe is inserted against or between a pair of opposing faces of members to be joined. Then, the probe is rotated. The rotation of the probe creates friction sufficient to generate heat to plasticize material at the opposing faces ***without melting*** the material. This results in a weld joint forming as the plasticized portions flow together and solidify to form the weld zone. (Emphasis added.)

By comparison, it will be seen that MIG refers to melting of the members to be joined and uses welding alloys such as 4043 for filler metal. Thus, it will be seen that these are different processes.

In Applicant's invention, aging is important to condition the metal for welding. That is, in Applicant's invention, the members to be welded are subjected to an artificial aging treatment for a time and temperature to produce or generate strengthening precipitates such as GP zones and coherent η' precipitate ($MgZn_2$). It is important to have these zones or precipitates to prevent overaging during the welding or friction stir joining in the heat affected zone. That is, the object of this aging treatment is to obtain a large density of GP zones and coherent η' precipitates having a very small size. If the incubation time for incoherent η' precipitates to form is greater than the time the affected zone is exposed to a temperature above 315°F, then overaging in the heat affected zone is prevented or significantly reduced. In Evancho, by comparison, because MIG welding involves melting of the member to be jointed, overaging is not a factor. Further, it should be noted that 2xxx series alloys do not form GP zones or η' precipitation phases.

It is respectfully submitted that Applicant's invention as claimed is patentable over Evancho for yet another reason. That is, Evancho is ***silent*** with respect to GP zones or coherent η' phases such as $MgZn_2$ or Cu-Mg-Zn since Evancho is concerned with a different alloy system.

It is respectfully submitted that Applicant's invention is patentable over Evancho for yet another reason. Evancho, at Table IV, is only concerned with a T4 or T6 age condition. Applicant's invention, by comparison, requires at claim 1(d), a second aging step referred to as T7X. Thus, not only is Evancho ***silent*** with respect to the method of joining the metal and also the alloys, but Evancho is also ***silent*** with respect to the aging process.

In the Office Action, claims 2-12 and 14-33 were rejected as follows:

Claims 2-12 and 14-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Waldron et al. (USPN 6168067 B1) in view of Park (USPN 4589932).

Waldron teaches a method of welding At alloy by aging before and after welding (col. 3 line 36 – col. 4 line 5 and col. 5 lines 22-36) to a predetermined temperature for a predetermined time to induce precipitation hardening (col. 6 lines 12-24), particularly to temperatures between 100 C and 300 C for a period of hours (col. 6 line 61 – col. 7 line 40). However the time and tempering schedules are not further disclosed. Neither are the alloys further disclosed.

Park teaches aging of Al alloys in series 2xxx, 6xxx and 7xxx such as 2024, 7475, 6061 (col. 9 lines 30-34) using known tempering schedules which include but are not limited to T5 and T6 which take place at typical temperatures of 220 F to 350 G for a typical period of hours (figures 2, 3, col. 1 lines 25-61, col. 6 lines 56-67, col. 13 line 45 - col. 14 line 9 and Table VII). The members are welded (col. 14 lines 63-68).

It would have been obvious to one of ordinary skill in the art at the time of the-invention to use known tempering schedules to maintain the desired strength, stiffness and ductility in both the weld zone and the heat-affected region in a simple and predictable manner. Al alloys in the 2xxx, 6xxx and 7xxx series are well known, cost- effective aircraft alloys.

It is respectfully submitted that claims 2-12 and 14-33 are patentable over Waldron taken in view of Park. As noted earlier, Waldron, col. 3, line 36 through col. 4, line 5, does not teach aging before welding. Instead, this is a reference to the prior practice of aging. Nowhere in this quotation is there any reference to welding. As noted earlier, the number 22 only refers to a structural member formed from a precipitation hardenable alloy having two or more alloying elements. Further, Waldron indicated under "Brief Description of the Drawings" that "FIG. 2A is a perspective view showing a structural member of preselected dimensions fabricated from a precipitation-hardenable metal alloy, as is known in the art." Again, there is no reference to welding.

With respect to Park, the only reference to welding is col. 14, lines 63-66, where it is indicated as follows:

> The improved products provide for many improved structural members including shipping pallets and containers made by shaping sheet or extrusion members and riveting or welding the assemblies together.

Clearly, this is not a teaching of Applicant's invention. That is, Park does not supply the steps missing in Waldron. It is respectfully submitted that Applicant's claims are patentable over the combination of Waldron and Park. It is further submitted that Applicant's invention is patentable over the combination of Waldron and Park for a further reason. That is, there is no suggestion to make the combination rejection.

The Court of Appeals for the Federal Circuit (CAFC) has continued to maintain the requirement of its predecessor court, the CCPA, that there be a ***suggestion of desirability*** of combinations and/or ***modifications in references*** being cited. In C. Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick, 221 USPQ 481 (Fed. Cir., 1984), at page 488, the Court stated:

> The claimed invention must be considered as a ***whole***, and the question is whether there is something in the ***prior art as a whole*** to suggest the desirability, and thus the obviousness, of making the combination.
>
> Nothing in the references ***alone or together*** suggests the claimed invention as a solution to the problem of crushing rigidly massive scrap. (Emphasis added.)

The Court then cited, with approval, In re Imperato, 179 USPQ 730, and In re Sernaker, 217 USPQ 1.

The CCPA and more recently the CAFC have recited the requirement of a suggestion for combining references in a number of cases. In the case of In re Imperato, the CCPA stated, at page 732:

> With regard to the principle rejection, we agree that combining the teaching of Schaefer with that of Johnson or Amberg would give the beneficial result observed by appellant. However, the mere fact that these disclosures ***can*** be combined does not make the combination obvious unless the art also contains something to suggest the desirability of the combination. (Emphasis in original.)

In Applicant's case, the main reference, Waldron, is concerned with welding solution heat treated material, and Applicant's invention is not concerned with welding solution heat treated material. The In re Imperato case was cited with approval by the District of Columbia District Court in Berghauser v. Dann, Commissioner of Patents, 204 USPQ 393 at page 396.

The CAFC, in ACS Hospital Systems, Inc. v. Montefiore Hospital, 221 USPQ 929 stated, at page 933:

> Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, ***absent some teaching or suggestion supporting the combination***. Under section 103, teachings of references can be combined ***only*** if there is some ***suggestion or incentive*** to do so. The prior art of record fails to provide any such suggestion or incentive. (Emphasis in original)

It is respectfully submitted that instead of supporting a suggestion, these two references are concerned with welding different materials. Thus, there can be no suggestion. Thus, for this additional reason, Applicant's invention is patentable over this combination.

In the Response to Arguments, the U.S. Patent Office alleges at page 4, paragraphs 7 and 8 of the Office Action, as follows:

> 7. Regarding applicant's argument that Waldron does not teach aging prior to welding see column 3 lines 36-47 which teach a preliminary aging (precipitation hardening) step.
> 8. Therefore the 102 rejection of claims 1 and 13 as anticipated by Waldron stands. The 103 rejection of claims 2-12 and 14-33 as obvious over Waldron in view of Park also stands.

Applicant notes that the U.S. Patent Office uses the words "preliminary aging". It is presumed what is meant is "aging before welding". Applicant has reproduced col. 3, lines 36-47 below:

> In order to improve the mechanical properties of the structural member 22, including the strength, hardness, and corrosion resistance of the member, the member is preferably precipitation hardened. Precipitation

> hardening of metal alloys is a process whereby the mechanical properties of the metal alloy are improved by the formation of uniformly dispersed particles or precipitates of one or more secondary phases within the original phase matrix. Precipitation hardening requires that the metal alloy undergo two heat treatment processes, the first process being a solution heat treatment and the second process being a precipitation heat treatment.

Applicant failed to find ***any*** reference to the word "preliminary" or "aging before welding" in this paragraph. If the U.S. Patent Office maintains this rejection, Applicant respectfully requests that the U.S. Patent Office pointed out the line in col. 3, lines 36-47 where these words occur. It must be remembered that Waldron is concerned with or only teaches ***solution heat treating*** prior to welding and is ***silent*** with respect to aging prior to welding. Accordingly, Applicant respectfully submits that Waldron is ***silent*** with respect to "preliminary aging". Thus, Applicant's invention is not anticipated or made obvious by Waldron.

In view of the above remarks, it will be noted that a sincere attempt has been made to place this application in condition for allowance. Therefore, reexamination and reconsideration are requested and allowance solicited at an early date.

Respectfully submitted,

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